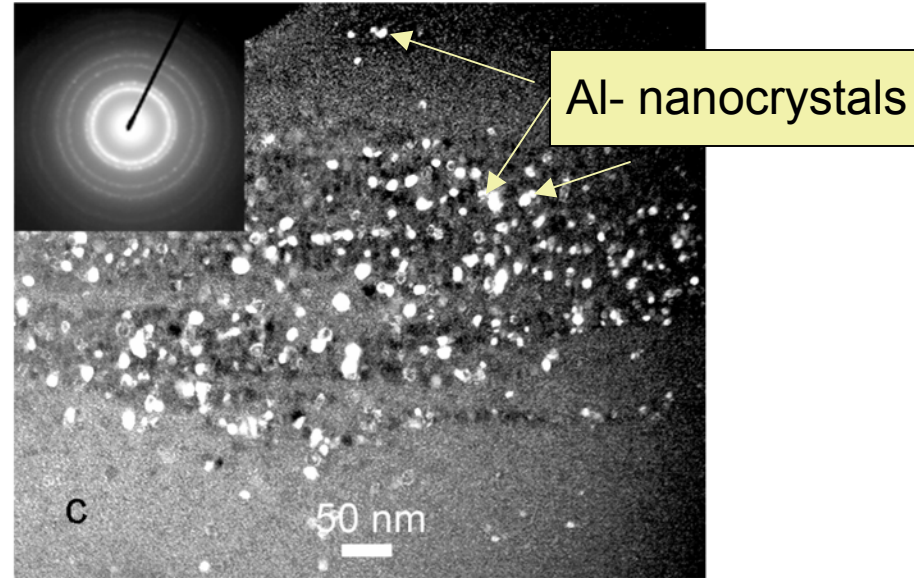
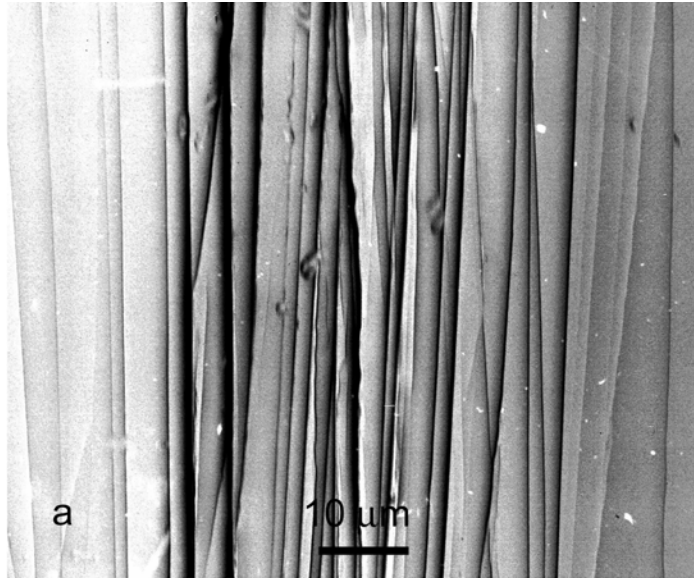


DMR-9972941(FRG)

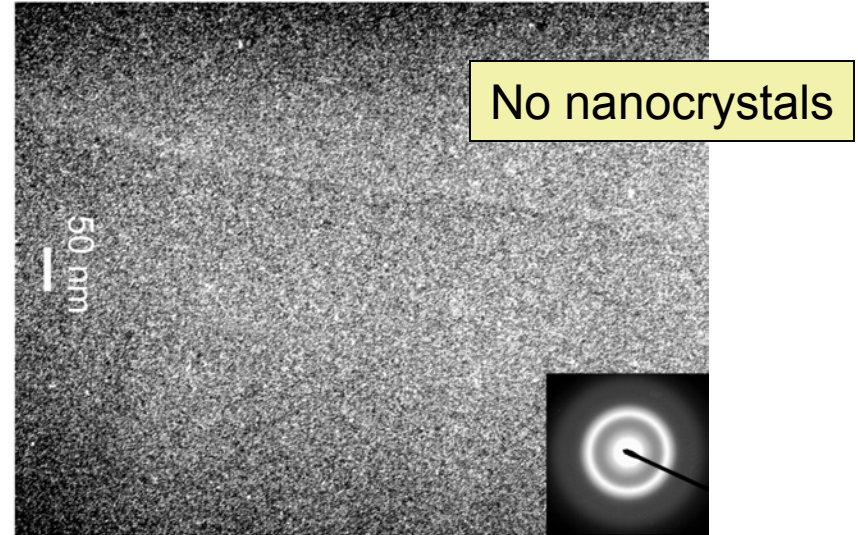
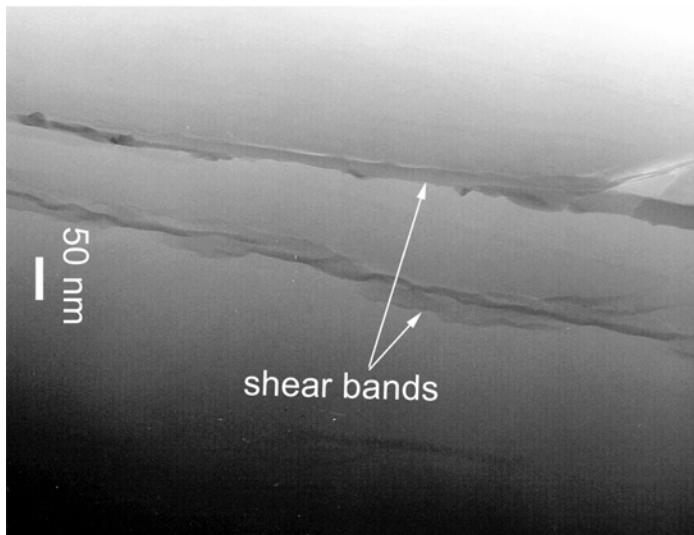
Walter Milligan, Michigan Tech U, DMR-9972941

- The next two slides are results on the program concerning mechanical instabilities in amorphous metal alloys.
- This program is with Michigan Tech University which is the lead institution. Walter Milligan is PI
- About 10 years ago we published a paper in Nature on crystallization within shear bands that occurred during deformation in Aluminum-based metallic glasses. It was unclear how this happened. The next slides contribute to clarifying the phenomenon.

298K



77K

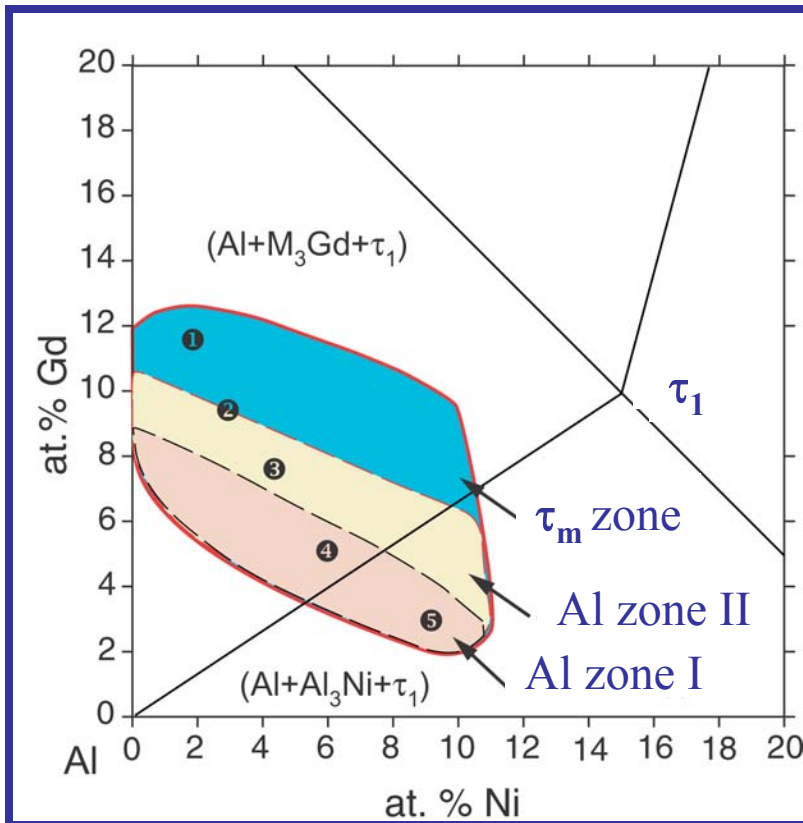


This slide shows SEM (top left) and TEM (bottom left) images of shear bands formed during deformation at room temperature and at liquid nitrogen temperature. The Dark Field TEM images (right) show that nanocrystals formed when the material was deformed at room temperature but not at 77K.

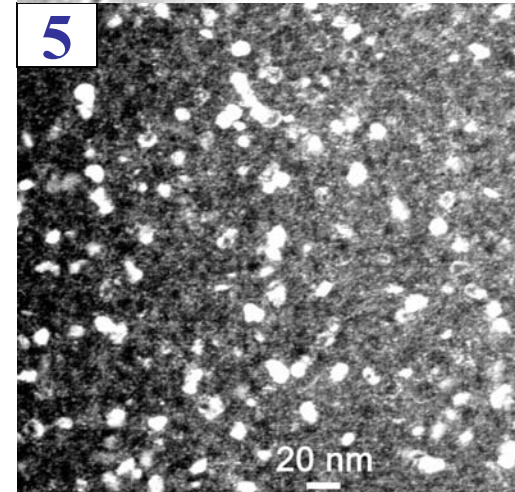
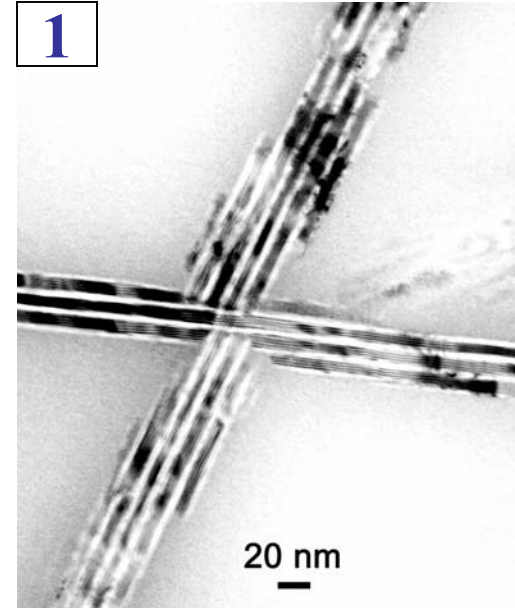
The results show that thermal effects are part of the reason for the nanocrystals forming. The original metallic glass is synthesized from an Al₈₇Ni₇Gd₆ alloy.



Crystalline Phase Formation Sequences at $\leq 250^\circ\text{C}$



Phase diagram and region where Al glass can be synthesized



This is a program where Michigan Tech is primary institution and Walter Milligan is the PI. At UVA we have been looking at the mechanical stability of amorphous alloys. One of our results involves the chemical ranges associated with what phase first appears during devitrification. The colored region in the phase diagram isotherm for Al-Ni-Gd (fully determined and optimized in this program) shows where good glass material can be formed in this ternary alloy system with rapid quenching. The red, yellow and blue regions identify which phase first appears on isothermal holding at 250 C. Al Zone 1 is the most studied because the nanocrystalline fcc aluminum phase is spherical, has a very high density and leads to a 20-30% improvement in strength. The micrograph on the right is taken from this region. Also, during deformation, alloys in this chemical range form similar nanocrystals within the shear band. The reason for this is the rich aluminum environment. The mechanical and thermal energy due to deformation leads to the formation of nanocrystallites within the shear band. If the Gd level is raised to about 10 at% and the Ni content is lowered to about 4 % the blue region is entered where the first phase transformation from the glass is a eutectic (maybe the finest ever... a nano-eutectic), top right hand picture.